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R2-29
Characterization of Imaging Luminance Measurement Devices (ILMDs)

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METAS

video photometer, imaging photometer, CCD luminance meter

ILMDs: product overview

Commercial (in alphabetic order, list not complete)

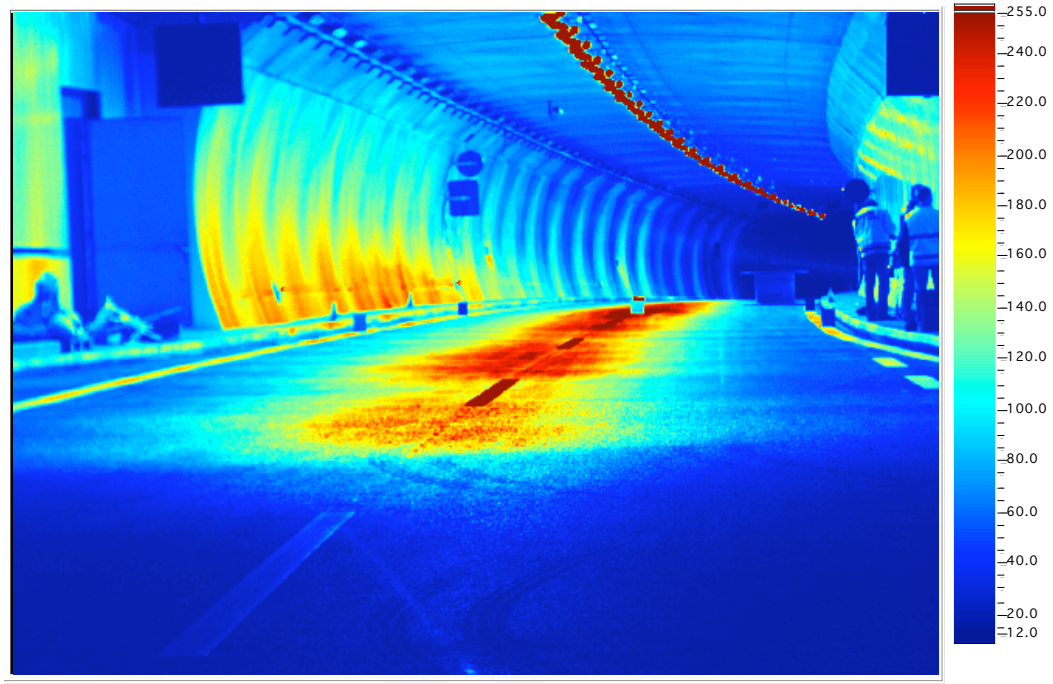
- (Eldim SA : EZContrast)
- Instrument Systems GmbH : LumiCam 1300
- Lumetrix Corp : IQCam 500
- Photo Research, Inc : PR 920
- Radiant Imaging, Inc : ProMetric 1600
- Technoteam GmbH : LMK 98-2
- Tricor Systems, Inc : Model 822
- etc

Non commercial:

- RPI (M. S. Rea and I. G. Jeffrey) : CapCalc
- LCPC (G. Brusque and H.Hubert) : Mélusine
- METAS (P. Blattner): XCD SX900 + V(λ) filter
- etc

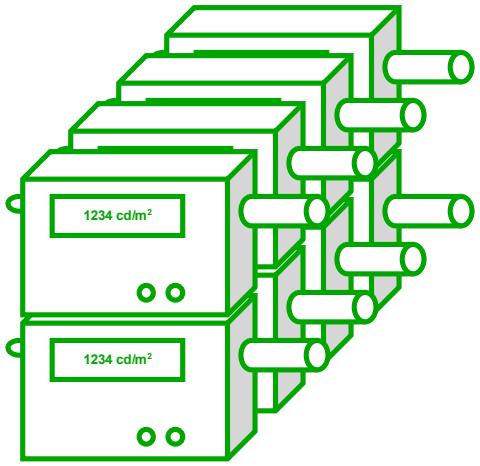
ILMDs: applications

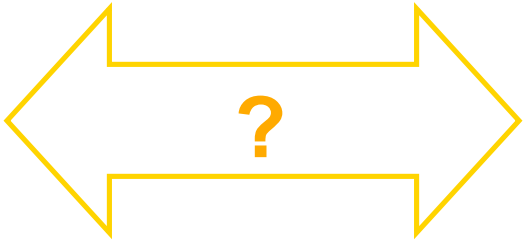
- **displays measurements (uniformity)**
- **indoor measurements (contrast, glare,...)**
- **measurement of lamps and luminaires**
- **near field goniophotometer**
- **testing of road and tunnel lighting**

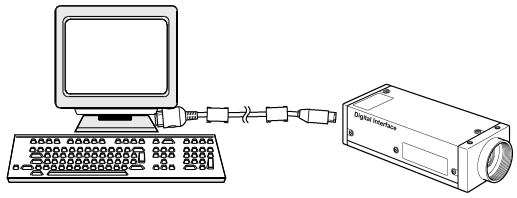


example : uniformity test of tunnel lighting

luminance meter versus imaging device







thousands of luminance meter working in parallel

video camera with V(λ)- filter

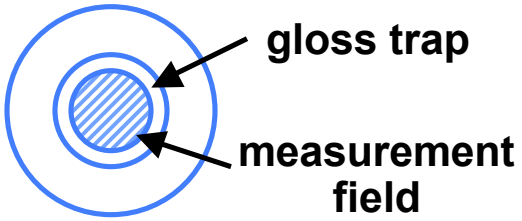
properties of luminance meter as defined by CIE publication 69-1986

- deviation of relative spectral responsivity from the V(l) function - > f_1'
- UV response, IR response -> u, r
- directional response -> $f_2(g)$
- effect from the surrounding field -> $f_2(u)$
- linearity error -> f_3
- error of display unit -> f_4
- temperature coefficient -> a
- fatigue -> f_5
- modulated radiation -> f_7
- polarization -> f_8
- range change -> f_{11}
- error of focus -> f_{12}
- lower/upper frequency limit -> f_l, f_u

properties of video camera system

- number of pixels (total, effective, output)
- cell size
- frame rate
- shutter speed
- noise
- dynamic range
- photo response non-uniformity (PRNU)
- dark signal non-uniformity (DSNU)
- defective pixels
- optical imaging parameter (MTF, distortion, etc)

CIE publication 69-1986: inconsistencies, missing parameters



Examples:

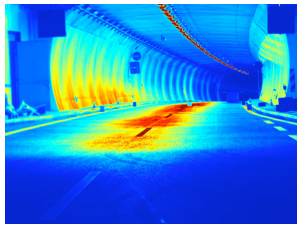
- **measurement of the effect of the surrounding field**
- **spatial homogeneity**

  (shading: depends on aperture, focusing distance)
- **cross talk between neighbor pixels**

  (blooming, smearing,data compression, etc)

other problems associated with ILMDs

- **timing problems (integration time : 0.01 msec - 1 sec)**
- **dark current (resp. drift of dark current), depends on temperature, position**
- **fixed aperture/ focus versus variable aperture/ focus**
- **image compression**
- **straylight**
- **Moire-effects**
-



and finally

- **data acquisition, manipulation, and evaluation made by a computer. There is always a mathematical transformation between the luminance value and the pixel value, typically**

ideal:

luminance(x,y,t) = pxl (x,y,t) * calibration

real:

luminance(x,y,t) = (pxl (x,y,t) - dark(x,y) - dark(t)) * calibration * shading (x,y) * nonlinearity (p

Review of specifications made by manufacturers

- only 2 out of 6 are specifying f_1'

- only 1 out of 6 specify the other CIE/69 parameters

- typical terms used are : “photometric accuracy” or “precision”

do we need a TC?

- from metrological point of view ILMDs are complex systems (traceability, software validation, etc)

- the parameters defined by CIE 69-1987 are not sufficient to characterize ILMDs

- there is some interest from industry to have some guidelines on how characterize ILMDs

however:
- only few manufactures are specifying there instruments in terms of CIE 69